Chapter 2

Amendments to the Specification

2.1 Underlining review

714 Amendments, Applicant's Action [R-6]

37 CFR 1.121 Manner of making amendments in application.

(b) Specification. Amendments to the specification, other than the claims, computer listings (1.96) and sequence listings (1.825), must be made by adding, deleting or replacing a paragraph, by replacing a section, or by a substitute specification, in the manner specified in this section.

(iii) The full text of any added paragraphs without any un-

derlining; and;

2.2 Remove sentence

In paragraph [0367], please remove the sentence:

"In this case, we require that $\zeta(s, s) = 0$."

The definition is reproduced below with the sentence struck out.

2 − 1 new definition

Definition 2.1 (Continuous RS-VAR) The regime s can make a transition at any point t in continuous time. The probability (conditional on a transition occurring) of a transition from s to s' is $\zeta(s', s)$. The probability of a transition out of state s is $\eta(s)dt$. ~~In this case, we require that $\zeta(s, s) = 0$~~. We also require that the $\zeta(s', s)$ are non-negative and sum to one.

There is a vector of state variables, v, that follows the process

$$dv = (b[s] + A[s]v)dt + G[s]dw \tag{2.1}$$

where v is an n by 1 vector of variables, b is an n by 1 vector of parameters, A is n by n, G is n by k and dw is k by 1. The vector dw is a vector of

Wiener processes, with mean 0 and variance dt. ♠

2.3 Additions to Specification

Please amend the specification by adding the following subsection to the specification at the end of the Best Modes chapter. This is the addition requested by the examiner in the interview in 2009. It introduces no new matter.

3 − 1 Steps in Regime Switching Economic Scenario Generation

Further clarification of the steps in regime switching economic scenario generation is given here.

3 − 1.1 Regime Switching VAR Time Node Step

Definition 2.2 (Regime Switching Time Node Step) The steps of the regime switching time node step consist of

1. Determine the regime index using regime determination means.

2. Use the regime index to map to the parameters for the VAR.

3. Use said mapped parameters in the VAR to generate the next economic state vector in time.

4. Use the regime index to map to auxiliary regime dependent data.

5. Use said auxiliary regime dependent data with the state variable to calculate auxiliary data at the time node.

6. Update the regime probability vector.

An alternative order is to determine the regime index for next period at the end of the time node step. The probability vector of the regime can also be updated at the start of the time node. What is important is the sequence of time node steps, and the start and stop point of the time node can be modified slightly with no consequential change.

Definition 2.3 (Update Regime Probability State Vector) 1. Multiply the collapsed regime probability state vector by the regime probability transition matrix. ♠

Definition 2.4 (Collapse Regime Probability State Vector)

1. Compute the cumulative probability vector of each regime by summing from 0 to the regime index. This forms a partition of the unit interval from 0 to 1. The lower endpoint is considered part of it and the upper end point not except for the last endpoint which is part of the last partion subinterval.

2. Generate a uniform random deviate.

3. Find the partition subinterval corresponding to this uniform random deviate.

4. Set the regime index to the index of this subinterval. ♠

For example, if there are two subintervals, one of probability 2/3 and one of 1/3, in the order regime 0 and regime 1, then a random deviate from 0 to 2/3 indicates regime 0 and one from 2/3 to 1 indicates regime 1. If the deviate is exactly 2/3, then regime 1 is chosen. Obviously, this whole arrangement can be varied in many ways so as to preserve the overall effect

of choosing a regime index based on the probability of the regimes.

3 – 1.2 Regime Switching Time Node Loop

Definition 2.5 (Regime Switching Time Node Loop) Regime Switching Time Node Loop consists of the steps

1. Regime Switching Time Node Loop Initiation Step.
2. Iterating over a loop of regime switching time nodes.
3. Post time node loop processing step.

3 – 1.3 Scenario

Definition 2.6 (Scenario)

1. Scenario initialization step
2. Time node loop
3. Post time loop processing

A scenario consists of a scenario initialization step, a time node loop, and a post time node processing step.

The method of generating a scenario on a computer the steps consisting of the scenario initialization step, the time node loop step, and the post time node processing step.

3 − 1.4 Scenario Initialization

Definition 2.7 (Scenario Initialization) 1. Reset time loop accumulators to zero.

2. Update scenario seed.

3 − 1.5 Scenario Loop

Definition 2.8 (Scenario Loop) 1. Scenario Loop Initialization

2. Scenario Loop

3. post scenario loop processing

3 − 1.6 Regime Switching Scenario

Definition 2.9 (Regime Switching Scenario) 1. time initialization step

2. Regime Switching time node loop

3. post time loop processing

A regime switching scenario consists of a scenario initialization step, a regime switching time node loop, and a post time node processing step.

The method of generating a regime switching scenario on a computer the steps consisting of the scenario initialization step, the regime switching time node loop step, and the post time node processing step.

3 – 1.7 Regime Switching Grids

A set of grids indexed by a regime index.

Consider the following procedure. A regime switching scenario generator that generates regime switching yield scenarios by first generating regime switching scenarios of the regime index and economic state variables and using said regime index at each time node to determine a yield grid and using the economic state variables at each time node to interpolate a yield from the yield grid so selected. This is intended for implementation on a computer in accordance with other statements in the specification.

3 – 1.8 One space variable one regime index example

The paper Tenney [120] has an extensive discussion of the Green's function numerical method including grid calculations. The Green's function in the case of one space variable and one regime index is indexed by g[i][s'][i'][s']. Here i is the discrete index of the space variable at the previous time node, and i' at the next time node, and s is the regime index at the earlier time node and s' the regime index at the next time node. Let b be the price of some security.

$$b[i][s] = \sum[i'][s']g[i][s][i'][s']b[i'][s'] \tag{2.2}$$

The regime probability transition matrix is independent of the state variable process so that the Green's function factors into the product of the transition matrix and a pure inside a regime Green's function, h,

$$g[i][s][i'][s'] = rho[s][s']h[s'][i][i'] \tag{2.3}$$

Note that for pricing the transition matrix rho is risk neutral, which can

differ from the real probability transition matrix of the regimes.

$$b[i][s] = \sum[s']rho[s][s'] \sum[i']h[s'][i][i']b[i'][s'] \tag{2.4}$$

$$v[i][s'] = \sum[i']h[s'][i][i']b[i'][s'] \tag{2.5}$$

$$b[i][s] = \sum[s']rho[s][s']v[i][s'] \tag{2.6}$$

3 – 1.9 Two space variable one regime index example

The Green's function in the case of two space variables and one regime index is indexed by g[i][j][s'][i'][j'][s']. Here i is the discrete index of the space variable at the previous time node, and i' at the next time node, and s is the regime index at the earlier time node and s' the regime index at the next time node. Let b be the price of some security.

$$b[i][j][s] = sumg[i][j][s'][i'][j'][s']b[i'][j'][s'] \tag{2.7}$$

The regime probability transition matrix is independent of the state variable process so that the Green's function factors into the product of the transition matrix and a pure inside a regime Green's function, h,

$$g[i][j][s'][i'][j'][s'] = rho[s][s']h[s'][i][j][i'][j'] \tag{2.8}$$

Note that for pricing the transition matrix rho is risk neutral, which can differ from the real probability transition matrix of the regimes.

$$b[i][j][s] = \sum[s']rho[s][s'] \sum[i']h[s'][i][j][i'][j']b[i'][j'][s'] \tag{2.9}$$

$$v[i][j][s'] = \sum[i']h[s'][i][j][i'][j']b[i'][j'][s'] \tag{2.10}$$

$$b[i][j][s] = \sum[s']rho[s][s']v[i][j][s'] \tag{2.11}$$

The functions h[s'][i][j][i'][j'] may be closed form solutions for the Green's function or fundamental solution as it is sometimes called or approximations. These are outlined in the references. See in particular the paper Tenney [120] for approximation methods.